In the Claims

Claims 1 - 120(Cancelled)

121. (New) A method for producing a substrate of plasma display comprising a base substrate having a plurality of display electrodes and a plurality of barrier ribs formed on a surface of the base substrate with a selected pitch, and phosphor layers formed over the display electrodes and in spaces between the barrier ribs, comprising:

(a) preparing

(a-1) a table mounted with the base substrate on an upper surface thereof,

(a-2) a paste applicator having a nozzle which includes (i) a flat plate provided with 150 to 2000 outlet holes for discharging a phosphor paste for emitting light of red, green or blue to form the phosphor layers and (ii) a manifold in which the phosphor paste is stored and which supplies the phosphor paste to the outlet holes, wherein the outlet holes have an average diameter of 10 to 500 μm, the outlet holes are formed with a pitch of 0.12 to 3 mm, and a lower surface of the flat plate is arranged to be located above and faces the upper surface of the table, and

(a-3) a moving device to move the table and the paste applicator relative to each other,

(b) moving the table and the paste applicator relatively with the moving device to effect a relative movement of each of the outlet holes along the lengthwise direction of the barrier ribs,

(c) discharging the phosphor paste continuously from the manifold through the outlet holes, and

(d) applying the phosphor paste discharged from the outlet holes into the spaces between the barrier ribs to form the phosphor layers therein during the relative movement.

122. (New) The method according to claim 121, wherein each space (S) between the adjacent barrier ribs and an average diameter (D) of the outlet holes satisfy the following formula:

$$10\ \mu m \leqq D \leqq S \leqq 500\mu m.$$

123. (New) The method according to claim 121, wherein a pitch of the outlet holes is 3m times of the pitch of the barrier ribs, where m is an integer of 1 to 10.

124. (New) The method according to claim 121, wherein each of the outlet holes satisfies the following formula:

$$L/D = 0.1 - 600$$

where L is the length of the outlet hole and D is the average diameter of the outlet holes.

125. (New) The method according to claim 121, wherein the average diameter of the outlet holes is in the range of 60 to 400 μm.

126. (New) The method according to claim 121, wherein the average diameter of the outlet holes is less than each space between the adjacent barrier ribs.

127. (New) The method according to claim 121, wherein the distance between top ends of the barrier ribs and a surface of the flat plate is kept at 0.01 to 2 mm.

128. (New) The method according to claim 121, wherein the manifold is connected to a negative pressure source and produces a negative internal pressure in the manifold to stop discharging of the phosphor paste.

129. (New) The method according to claim 121, wherein after starting of the relative movement, discharging of the phosphor paste is started, and before stopping of the relative movement, discharging of the phosphor paste is stopped.

130. (New) The method according to claim 121, further comprising drying the phosphor layers with heat.

131. (New) The method according to claim 121, wherein the phosphor paste stored in the manifold has a viscosity of 2 to 50 Pa·s.

132. (New) The method according to claim 121, wherein the barrier ribs have a pitch of 100 to 250 μm between adjacent barrier ribs, a width of 15 to 40μm in each of the barrier ribs, and a height of 60 to 170 μm in each of the barrier ribs.

133. (New) The method according to claim 121, wherein top ends of the barrier ribs are black.

134. (New) A method for producing a substrate of plasma display comprising a base substrate having a plurality of display electrodes and a plurality of barrier ribs formed on a surface of the base substrate with a selected pitch, and phosphor layers formed over the display electrodes and in spaces between the barrier ribs, comprising:

(a) preparing

(a-1) a table mounted with the base substrate on an upper surface thereof,

(a-2) a first paste applicator having a nozzle which includes (i) a flat plate provided with 150 to 2000 outlet holes for discharging a phosphor paste for emitting light of red, green or blue to form the phosphor layers and (ii) a manifold in which the phosphor paste is stored and which supplies the phosphor paste to the outlet holes, wherein the outlet holes have an average diameter of 10 to 500 μm, the outlet holes are formed with a pitch of 0.12 to 3 mm, and a lower surface of the flat plate is arranged to be located above and faces the upper surface of the table,

(a-3) a second paste applicator having a nozzle which includes (i) a flat plate provided with 150 to 2000 outlet holes for discharging a phosphor paste for emitting light of red, green or blue to form the phosphor layers and (ii) a manifold in which the phosphor paste is stored and which supplies the phosphor paste to the outlet holes, wherein the outlet holes have an average diameter of 10 to 500 μm, the outlet holes are formed with a pitch of 0.12 to 3 mm, and a lower surface of the flat plate is arranged to be located above and faces the upper surface of the table,

(a-4) a first moving device to move the table and the first paste applicator relative to each other,

(a-5) a second moving device to move the table and the second paste applicator relative to each other,

(b) moving the table and the first and second paste applicators relatively by the first and second moving devices to effect a relative movement of each of the outlet holes in the first paste applicator along a lengthwise direction of the barrier ribs and a relative movement of each of the outlet holes in the second paste applicator along a lengthwise direction of the barrier ribs,

(c) discharging the phosphor paste continuously from the manifold through the outlet holes in the first applicator and the phosphor paste continuously from the manifold through the outlet holes in the second applicator, and

(d) applying the phosphor paste discharged from the outlet holes in the first and second paste applicators into the spaces between the barrier ribs to form the phosphor layers therein during the relative movements of the first and second paste applicators.

135. (New) The method according to claim 134, wherein discharging the phosphor paste from the first paste applicator and discharging the phosphor paste from the second paste applicator are simultaneously carried out.

136. (New) The method according to claim 134, wherein a speed of the relative movement of the first paste applicator and a speed of the relative movement of the second paste applicator are the same.

137. (New) The method according to claim 134, wherein the phosphor paste discharging from the outlet holes in the first past applicator and the phosphor paste discharging from the outlet holes in the second paste applicator are different colors.

138. (New) A method for producing a substrate of plasma display comprising a base substrate having a plurality of display electrodes and a plurality of barrier ribs formed on a surface of the base substrate with a selected pitch, and phosphor layers formed over the display electrodes and in spaces between the barrier ribs, comprising:

(a) preparing

(a-1) a table mounted with the base substrate on an upper surface thereof,

(a-2) a paste applicator comprising a first nozzle, a second nozzle and a third nozzle, wherein

(a-2-1) the first nozzle includes (i) a first flat plate provided with a first set of 150 to 2000 outlet holes for discharging a first phosphor paste for emitting light of red to form the phosphor layers and (ii) a first manifold in which the first phosphor paste is stored and which supplies the first phosphor paste to the first set of outlet holes, wherein the first set of outlet holes have an average diameter of 10 to 500 μm, the first set of outlet holes are formed with a pitch of 0.12 to 3 mm and

the first set of outlet holes are provided along a first straight line,

(a-2-2) the second nozzle includes (i) a second flat plate provided with a second set of 150 to 2000 outlet holes for discharging a second phosphor paste for emitting light of green to form the phosphor layers and (ii) a second manifold in which the second phosphor paste is stored and which supplies the second phosphor paste to the second set of outlet holes, wherein the second set of outlet holes have an average diameter of 10 to 500 μm, the second set of outlet holes are formed with a pitch of 0.12 to 3 mm and the second set of outlet holes are provided along a second straight line parallel to the first straight line, and

(a-2-3) the third nozzle includes (i) a third flat plate provided with a third set of 150 to 2000 outlet holes for discharging a third phosphor paste for emitting light of blue to form the phosphor layers and (ii) a third manifold in which the third phosphor paste is stored and which supplies the third phosphor paste to the third set of outlet holes, wherein the third set of outlet holes have an average diameter of 10 to 500 μm, the third set of outlet holes are formed with a pitch of 0.12 to 3 mm and the third set of outlet holes are provided along a third straight line parallel to the first straight line, and

(a-2-4) wherein lower surfaces of the first, second and third flat plates are arranged to be located above and face the upper surface of the table,

(a-3) a moving device to move the table and the paste applicator relative to each other,

(b) moving the table and the paste applicator relatively with the moving device to effect a relative movement of each of the three sets of the outlet holes along a lengthwise direction of the barrier ribs,

(c) discharging the phosphor paste continuously and simultaneously from the first manifold through the first set of outlet holes, from the second manifold through the second set of outlet holes and from the third manifold through the third set of outlet holes, and

(d) applying the respective phosphor pastes discharged from the respective outlet holes into the respective spaces between the barrier ribs to form the respective phosphor layers therein during the relative movement.

139. (New) The method according to claim 138, wherein the shortest distance between the adjacent two of the first, second and third straight lines is 600 μm or more.

140. (New) A method for producing a plasma display comprising:

(a) producing a first substrate comprising a base substrate having a plurality of display electrodes and a plurality of barrier ribs formed on a surface of the base substrate with a selected pitch and phosphor layers formed over the display electrodes and in spaces between the barrier ribs, based on the method for producing a substrate defined in claim 121,

(b) preparing a second substrate having a plurality of address electrodes,

(c) joining the first substrate and the second substrate, and

(d) injecting a rare gas between the first substrate and the second substrate.

141. (New) An apparatus for producing a substrate of a plasma display comprising a base substrate having a plurality of display electrodes and a plurality of barrier ribs formed on a surface of the base substrate with a selected pitch, and phosphor layers formed over the display electrodes and in spaces between the barrier ribs, the apparatus comprising:

(a) a table on an upper surface of which the base substrate is mounted,

(b) a paste applicator comprising a nozzle having a manifold provided therein to store a phosphor paste for emitting light of red, green or blue to form the phosphor layers and a plurality of outlet holes to discharge the phosphor paste from the manifold to the spaces between the barrier ribs of the base substrate mounted on the upper surface of the table, and

(c) a moving device to move the table and the paste applicator relative to each other,

wherein a bottom surface of the nozzle is formed with a flat plate, the outlet holes are formed in and through the flat plate, a number of the outlet holes formed in the flat plate is from 150 to 2000, an average diameter of the outlet holes is 10 to 500 μm, a pitch of the outlet holes is from 0.12 to 3 mm, and the bottom surface of the flat plate is located above and faces the upper surface of the table.

142. (New) The apparatus according to claim 141, wherein each of the outlet holes satisfies the following formula:

$$L/D = 0.1 - 600$$

where L is the length of the outlet hole and D is the average diameter of the outlet holes.

143. (New) The apparatus according to claim 141, wherein the average diameter of the outlet holes is in the range of 60 to 400 μm.

144. (New) The apparatus according to claim 141, wherein the bottom surface of the flat plate and/or an inner wall of each of the outlet holes is coated with a fluorine based resin.

145. (New) The apparatus according to claim 141, wherein the bottom surface of the flat plate and/or an inner wall of each of the outlet holes is coated with an amorphous carbon.

146. (New) The apparatus according to claim 141, further comprising a pressure adjuster capable of setting pressure of the phosphor paste in the manifold in a range from

atmospheric pressure to a negative pressure, and a controller to control timing of change of the pressure by the pressure adjuster.

147. (New) The apparatus according to claim 141, further comprising:

a first detector for detecting position of at least one of the outlet holes,

a second detector for detecting position of at least one of the barrier ribs of the base substrate to be mounted on the upper surface of the table,

a third detector for detecting position of at least one of the top ends of the barrier ribs of the base substrate to be mounted on the upper surface of the table,

a fourth detector for detecting position of the bottom surface of the flat plate, and

a controller for controlling starting and ending of discharge of the phosphor paste from the outlet holes in response to a relative position between the outlet holes and the base substrate.

148. (New) The apparatus according to claim 141, further comprising:

an adjuster to adjust an inclination degree of the bottom surface of the flat plate to top ends of the barrier ribs of the base substrate to be mounted on the upper surface of the table, and

a controller for keeping the bottom surface of the flat plate at a predetermined distance and parallel to the top ends of the barrier ribs of the base substrate to be mounted on the upper surface of the table.

149. (New) The apparatus according to claim 141, further comprising a detector for detecting the position of the phosphor paste discharged from at least one of the outlet holes onto corresponding spaces between adjacent barrier ribs of the base substrate to be mounted on the upper surface of the table.

150. (New) The apparatus according to claim 141, further comprising:

a detector for detecting the number of the barrier ribs or spaces between the barrier ribs of

the base substrate to be mounted on the upper surface of the table, and

a recognizing means for recognizing spaces to be coated with the phosphor paste based on the detected number of the barrier ribs or the spaces.

151. (New) The apparatus according to claim 141, further comprising:

a reference mark detector for detecting a reference mark provided on the base substrate to be mounted on the upper surface of the table, and

a controller for controlling movement of the moving device so that the outlet holes are positioned above the spaces to be coated with the phosphor paste between the barrier ribs of the base substrate to be mounted on the upper surface of the table.

152. (New) An apparatus for producing a substrate of plasma display comprising a base substrate having a plurality of display electrodes and a plurality of barrier ribs formed on a surface of the base substrate with a selected pitch, and phosphor layers formed over the display electrodes and in spaces between the barrier ribs, the apparatus comprising:

(a) a table on an upper surface of which the base substrate is mounted,

(b) a first paste applicator comprising a nozzle having a manifold provided therein to store a phosphor paste for emitting light of red, green or blue to form the phosphor layers and a plurality of outlet holes to discharge the phosphor paste from the manifold to the spaces between the barrier ribs of the base substrate mounted on the upper surface of the table,

(c) a second paste applicator comprising a nozzle having a manifold provided therein to store a phosphor paste for emitting light of red, green or blue to form the phosphor layers and a plurality of outlet holes to discharge the phosphor paste from the manifold to the spaces between the barrier ribs of the base substrate mounted on the upper surface of the table,

(d) a first moving device to move the table and the first paste applicator relative to each other,

(e) a second moving device to move the table and the second paste applicator relative to each other,

wherein each of the bottom surfaces of the nozzles provided in the first and second paste applicators is formed with a flat plate, the outlet holes are formed in and through the flat plate, a number of the outlet holes formed in the flat plate is from 150 to 2000, an average diameter of the outlet holes is 10 to 500 μm, a pitch of the outlet holes is from 0.12 to 3 mm, and the bottom surface of the flat plate is located above and faces the upper surface of the table.

153. (New) An apparatus for producing a substrate of plasma display comprising a base substrate having a plurality of display electrodes and a plurality of barrier ribs formed on a surface of the base substrate with a selected pitch, and phosphor layers formed over the display electrodes and in spaces between the barrier ribs, the apparatus comprising:

(a) a table on an upper surface of which the base substrate is mounted,

(b) a paste applicator comprising:

(b-1) a first nozzle having a first manifold provided therein to store a first phosphor paste for emitting light of red to form the phosphor layers and a first plurality of outlet holes to discharge the first phosphor paste from the first manifold to the spaces between the barrier ribs of the base substrate mounted on the upper surface of the table,

(b-2) a second nozzle having a second manifold provided therein to store a second phosphor paste for emitting light of green to form the phosphor layers and a second plurality of outlet holes to discharge the second phosphor paste from the second manifold to the spaces between the barrier ribs of the base substrate mounted on the upper surface

of the table, and

(b-3) a third nozzle having a third manifold provided therein to store a third phosphor paste for emitting light of blue to form the phosphor layers and a third plurality of outlet holes to discharge the third phosphor paste from the third manifold to the spaces between the barrier ribs of the base substrate mounted on the upper surface of the table,

(c) a moving device to move the table and the paste applicator relative to each other,

wherein each of the bottom surfaces of the first, second and third nozzles is formed with a flat plate, the outlet holes are formed in and through the flat plate, a number of the outlet holes formed in the flat plate is from 150 to 2000, an average diameter of the outlet holes is 10 to 500 μm, a pitch of the outlet holes is from 0.12 to 3 mm, and the bottom surface of the flat plate is located above and faces the upper surface of the table.